ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT WATER DIVISION - WATER SUPPLY PROGRAM ADMINISTRATIVE CODE

CHAPTER 335-7-6 SURFACE WATER SOURCES AND TREATMENT

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335-7-6-.01 Definitions.

The following words and phrases, unless a different meaning is plainly required by the context, shall have the following meaning:

(a) Bag filters--pressure-driven separation devices that remove particulate matter larger than 1 micrometer using an engineered porous filtration media. They are typically constructed of a non-rigid, fabric media housed in a pressure vessel in which the direction of flow is from the inside of the bag to outside.

(b) Bank filtration--a water treatment process that uses a well to recover surface water that has naturally infiltrated into ground water through a riverbed or bank(s). Infiltration is typically enhanced by the hydraulic gradient imposed by a nearby pumping water supply or other well(s).

(c) Cartridge filters--pressure-driven separation devices that remove particulate matter larger than 1 micrometer using an engineered porous filtration media. They are typically constructed as a rigid or semi-rigid, self-supporting filter elements housed in pressure vessels in which flow is from the outside of the cartridge to the inside.

(d) Clarification--a process with the primary purpose of reducing the concentration of suspended matter in a liquid.

(e) Comprehensive performance evaluation (CPE)--a thorough review and analysis of a treatment plant's performance-based capabilities and associated administrative, operation and maintenance practices. It is conducted to identify factors that may be adversely impacting a plant's capability to achieve compliance and emphasizes approaches that can be implemented without significant capital improvements. The comprehensive performance evaluation must consist of at least the following components: Assessment of plant performance; evaluation of major unit processes; identification and prioritization of performance limiting factors; assessment of the applicability of comprehensive technical assistance; and preparation of a CPE report.

(f) Conventional treatment--treatment of surface water or ground water under the influence that includes the addition of a coagulant to the raw water and undergoes coagulation, flocculation, sedimentation, filtration and disinfection. Filtration is by gravity and the media is either slow sand or dual/multi-media.

(g) Day Tank--a tank sized to hold one day's average chemical usage.

(h) Disinfection profile--a summary of daily Giardia lamblia inactivation through the treatment plant and to the first customer.

(i) Disinfection segment--each individually confined volume of water before the first customer between the first point of disinfectant addition and the next point of disinfectant addition or the first customer.

(j) Enhanced coagulation--the addition of sufficient coagulant for improved removal of disinfection byproduct precursors by conventional filtration treatment.

(k) Filter profile--a graphical representation of individual filter performance, based on continuous turbidity measurements or total particle counts versus time for an entire filter run, from startup to backwash inclusively, that includes an assessment of filter performance while another filter is being backwashed.

(l) Flowing stream--a course of running water flowing in a definite channel.

(m) Intake--the structure where raw water is removed from source water for the purpose of transferring it to a water treatment plant.

(n) Lake/reservoir--refers to natural or manmade basin or hollow of the Earth's surface in which water collects or is stored that may or may not have a current or single direction of flow.

(o) Membrane filtration--a pressure or vacuum driven separation process in which particulate matter larger than 1 micrometers is rejected by an engineered barrier, primarily through size-exclusion mechanism, and which has a measurable removal efficiency of a target organism that can be verified through a direct integrity test. This definition includes the common membrane technologies of microfiltration, ultrafiltration, nanofiltration, and reverse osmosis.

(p) Mixing Basin--a tank, basin or pipe wherein agitation is applied to increase the dispersion rate of chemicals.

(q) Multi-stage flocculation--two or more defined stages or compartments that impart different G values to the coagulated water.

(r) Plant intake--the works or structures at the head of a conduit through which water is diverted from a source (e.g., river or lake) into a treatment plant.

(s) Presedimentation--a preliminary treatment process used to remove gravel, sand and other particulate material from the source water though settling before the water enters the primary clarification and filtration processes in a treatment plant.

(t) Raw water--water within a watershed used to supply an intake structure.

(u) Two-stage lime softening--a process in which chemical addition and hardness precipitation occur in each of two distinct unit clarification processes in series prior to filtration.

(v) SUVA--Specific Ultraviolet Absorption at 254 nanometers (nm), an indicator of the humic content of a water. It is a calculated parameter obtained by dividing a sample's ultraviolet absorption at a wavelength of 254 nm (UV) (in m-1) 254by its concentration of dissolved organic carbon (DOC) (in mg/L).

Author: Joe Alan Power, Edgar K. Hughes, Dennis D. Harrison
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335-7-6-.02 Applicability.

These regulations apply to all public water systems using or proposing to utilize a surface water or ground water under the influence of surface water source as a supply of drinking water.

Author: Joe Alan Power, Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: May 23, 2977. **Repealed and Readopted:** January 4, 1989; October 31, 1990; effective December 5, 1990. (Rule was renumbered from .01 to .02, as per certification filed December 21, 1998; effective January 25, 1999, with no changes made to the rule.) **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005.

335-7-6-.03 Source Selection Report.

Any applicant for a permit proposing to utilize surface water or groundwater under the influence of surface water as a source for a drinking water treatment plant shall file a report in electronic format, unless paper format is approved by the Department in advance, including the following:

(a) A map of the proposed source showing the drainage area in the vicinity of the proposed intake.

(b) Information showing the raw water source meets raw water quality criteria and has a use classification of public water supply in accordance with ADEM Admin. Code chapter 335-6-11.

(c) The system must provide verification that the source has adequate capacity at all times, even during drought years, to meet the proposed capacity of the water treatment plant.

(d) An approved source water assessment meeting the requirements of ADEM Admin. Code r. 335-7-15.

(e) Twelve months of raw water data, including the following:

1. weekly results of turbidity, temperature, pH, alkalinity, iron, manganese and color,

2. monthly results for total coliform and e. coli bacteria,

3. quarterly analysis results from a certified laboratory for all contaminants identified in the primary and secondary standards and any listed unregulated contaminants,

4. quarterly analysis indicating the potential maximum TTHM and HAA5 levels, and

5. monthly analyses of the TOC levels, *Cryptosporidium* and *Giardia*.

(f) A study showing the source will be responsive to the treatment outlined in the engineering report and that the expected finished water will comply with all primary and secondary standards.

(g) The Department's written concurrence of this report shall be received by the applicant prior to the submittal of a permit application package for construction of the intake.

Author: Edgar K. Hughes, Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **New Rule:** Filed December 21, 1998; effective January 25, 1999. **Amended:** Filed May 2, 2000; effective June 6, 2000. **Amended:** Filed December 24, 2003; effective January 28, 2004. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005. **Amended:** Filed December 18, 2007; effective January 22, 2008. **Amended:** Filed August 21, 2012; effective September 25, 2012.

335-7-6-.04 Treatment Requirements.

The treatment provided for all surface water and ground water under the influence of surface water must meet the following requirements:

(a) Conventional surface water treatment shall be required at all surface water or ground water under the influence of surface water treatment facilities, unless otherwise approved by the Department.

(b) Provisions to bypass various processes in the treatment are prohibited, unless approved by the Department.

(c) Treatment provided shall produce water meeting both primary and secondary standards with a goal for particulate removal to result in a clarified water turbidity less than 2.0 NTU when the raw water turbidity level is greater than 10.0 NTU, a clarified water turbidity level less than 1.0 NTU when the raw water turbidity level is less than or equal to 10.0 NTU and a filtered water turbidity level less than 0.10 NTU, and be free of *Giardia lamblia*, cryptosporidium oocysts, viruses, heterotrophic plate count bacteria, and Legionella.

(d) No exemptions from the filtration and disinfection processes are allowed.

(e) The treatment requirements consist of installing and properly operating water treatment processes which achieve the following:

1. At least 99.9 percent removal and/or inactivation of *Giardia lamblia* cyst and at least 99 percent removal of cryptosporidium oocyst prior to service of the first customer, and

2. 99.99 percent removal and/or inactivation of viruses prior to service of the first customer.

3. Drinking water meeting all primary and secondary standards.

(f) Plants with a raw water source receiving treated or untreated wastewater or having a watershed with high contaminant potential may be required to install equipment to measure, count and record particle size of particles passing through plant filters to demonstrate compliance with the requirements of 335-7-6-.04(e).

Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: May 23, 1977. **Repealed and Readopted:** January 4, 1989; October 31, 1990. **Amended:** September 23, 1992; effective November 9, 1992. **Amended:** Filed November 28, 1995; effective January 2, 1996. (Rule was renumbered from .03 to .11, as per certification filed December 21, 1998; effective January 25, 1999, with no changes made to the rule.) **Amended:** Flied May 2, 2000; effective June 6, 2000. **Amended:** Filed April 25, 2003; effective May 30, 2003. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005. **Amended:** Filed August 21, 2012; effective September 25, 2012.

335-7-6-.05 Surface Water Intake Structures.

All surface water intake structures that are permitted for construction after December 31, 2005 must meet the following requirements, unless a waiver is granted by the Department:

(a) Provide for the withdrawal of water from more than one level unless written approval is obtained from the Department.

(b) All motors and electrical controls must be located above grade and the 100 yearflood level except when submersible pumps are approved by the Department.

(c) Structures must be equipped with removable or traveling screens before the pump suction well or equipped with other means for clearing the screens.

(d) A minimum of two pumps sized to meet the treatment plant design capacity are required. Intakes with more than two pumps must be able to meet the treatment plant design capacity with the largest pump out of service.

(e) Incorporate into the design provisions for preventing surge or water hammer damage when necessary.

(f) Equip discharge piping from the raw water pumping station with a device capable of measuring and totaling the flow.

(g) Provide ample space in the interior of the raw water pumping station for adequate maintenance.

(h) Structures should have adequate lighting to provide for the necessary observation of equipment operation.

Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **New Rule:** Filed December 21, 1998; effective January 25, 1999. **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005. **Amended:** Filed August 21, 2012; effective September 25, 2012.

335-7-6-.06 Conventional Treatment Processes.

All surface water and ground water under the influence of surface water treatment plants utilizing a conventional treatment process must meet the following requirements:

(a) Existing facilities (facilities constructed or permitted for construction prior to January 1, 2006) may obtain a waiver from these regulations for any portion that they currently do not comply with. Existing facilities modified after this date must include provisions to address these regulations.

(b) Mixing Basins: Provision shall be made for the rapid disbursement of coagulants in the raw water and the development of a floc according to the following:

1. A minimum of two mixing units shall be provided when mechanical mixers are used. Hydraulic mixing is permitted with prior approval from the Department.

2. Provision shall be made for the application of chemicals at various points in the treatment train.

3. A minimum detention time of 30 minutes shall be provided under normal flow conditions in the flocculation basin. The plant must demonstrate a minimum of sixty percent detention time before requesting authorization to place the water treatment plant into service.

4. A minimum of two multi-stage flocculation units is required.

5. Each flocculation unit shall be equipped with variable speed drive unless hydraulic flocculation is utilized.

(c) Settling Basins: Provision shall be made for the settling of floc according to the following:

1. A minimum of two sedimentation basins is required. A minimum settling period of four hours shall be provided in the basins. The plant must demonstrate a minimum of sixty percent settling time before requesting authorization to place the water treatment plant into service. Existing plants having only one sedimentation basin may obtain a waiver from the Department for the requirement for two sedimentation basins if the Department determines that construction of the additional basin would have a negative impact on plant and system operation.

2. Each basin shall be equipped with an automatic sludge removal system and drains.

3. Each basin shall be designed with a minimum length to width ratio of 2:1 and shall have a maximum surface overflow rate of 850 gallons per day per square foot of basin area.

4. Inlet and outlet design shall prevent short-circuiting and destruction of floc particles.

(d) Conventional Filtration: Provision shall be made for the filtering of settled water according to the following:

1. A minimum of two gravity type rapid dual media filters are required.

2. The rate of filtration shall not exceed two gallons per minute per square foot of filter bed area unless otherwise approved by the Department.

3. Each filter must be equipped with filter-to-waste capability.

4. Sufficient head room shall be available above filters to allow inspection of the facility and access to the filter and sufficient illumination shall be provided above all filters that are enclosed.

5. Sample taps shall be provided on the filter effluent line from each filter.

6. Media used shall meet departmental design requirements.

7. A method of constantly controlling the rate of flow through each filter shall be provided.

8. A filter flow indicator and head loss indicator shall be present at each filter.

9. Provisions shall be made for continuously monitoring and recording the turbidity of the effluent from each filter and the filter-to-waste.

10. Equipment shall be installed and maintained to allow proper cleaning and backwashing of filters. Filters shall be backwashed when the head loss approaches or exceeds six feet, effluent turbidity approaches or exceeds 0.3 NTU, or there is a rapid increase in effluent turbidity. Water used for all backwashing procedures shall meet primary and secondary drinking water standards. A flow control device shall be available to regulate and indicate the rate of backwashing. Filters shall be designed to allow the operator to observe the backwashing procedures. After backwashing, the filter shall be filtered to waste until the turbidity in the filter to waste water is approximately 0.1 NTU, but no greater than 0.3 NTU.

Author: Edgar K. Hughes

Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: New Rule: Filed December 21, 1998; effective January 25, 1999. **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005.

335-7-6-.07 Alternative Treatment Processes.

All surface water and ground water under the influence of surface water treatment plants utilizing anything other than conventional treatment processes must meet the following requirements:

(a) Existing facilities (facilities constructed or permitted for construction prior to January 1, 2006) may obtain a waiver from these regulations for any portion that they currently do not comply with. Existing facilities modified after this date must include provisions to address these regulations.

(b) The minimum treatment processes required are mixing, clarification, conventional filtration and disinfection. Any deviation must have written Departmental approval.

(c) A pilot study is required to demonstrate the effectiveness of the process to achieve the required log removals of Giardia lamblia cyst, Cryptosporidium oocysts, and viruses as specified in rule 335-7-6-.04(e) on the proposed raw water source. The duration of the pilot study must be a minimum of 30 consecutive days. The pilot study shall be conducted during a time when raw water turbidity is historically at its highest. A report on the pilot study must be submitted to the Department and approval obtained prior to the submittal of an application for a permit to construct.

(d) The Department will determine minimum design requirements for each individual treatment technology as they are proposed. These design requirements will be based on manufacturer recommendations and/or the results of the pilot study for the proposed treatment technology.

Author: Edgar K. Hughes, Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: New Rule: Filed December 21, 1998; effective January 25, 1999. **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005. **Amended:** Filed December 18, 2007; effective January 22, 2008. **Amended:** Filed December 14, 2010; effective January 18, 2011.

335-7-6-.08 Membrane Filtration.

Membrane filtration units may be used in place of conventional filtration. Membrane filtration units must meet the following requirements:

(a) A pilot study may be required to demonstrate the effectiveness of membrane filtration to achieve the required log removals of *Giardia lamblia* cyst, *Cryptosporidium* oocysts, and viruses a specified in rule 335-7-6-.04(e) on the proposed raw water source. The duration of the pilot study must be a minimum of 30 consecutive days. The pilot study shall be conducted during a time when raw water turbidity is historically high. A report on the pilot study must be submitted to the Department and approval obtained prior to the submittal of a construction application permit.

(b) Maximum flow rates through membrane filtration units will be determined based on the lowest historical water temperature for the raw water source.

(c) A minimum of two membrane filtration units is required.

(d) Each membrane train shall have a turbidimeter and an instrument capable of measuring particles less than 3 micrometers installed on the effluent side of the train.

Author: Edgar K. Hughes, Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **New Rule:** Filed December 21, 1998; effective January 25, 1999. **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005. **Amended:** Filed December 18, 2007; effective January 22, 2008.

335-7-6-.09 High Rate Filtration Requirements.

Filtration rates for conventional filters greater than two gpm per square foot of filter area require a permit modification. For high rate filtration approval, the following requirements must be met prior to the system requesting a permit modification:

(a) The duration of the High Rate Study must be a minimum of 30 consecutive days and during a time when raw water turbidity is historically at its highest. The plant must be operated 24 hours per day for the duration of the study.

(b) All treatment units must be utilized for the entire duration of the High Rate Study and operated at the proposed capacity. Any deviation from this requirement requires Departmental approval.

(c) The coagulation process shall be controlled either by zeta potential, streaming current detector or other approved methods.

(d) Indicating and recording turbidity monitors shall be provided for monitoring the turbidity of:

1. Raw water;

2. Clarified water prior to filtration at representative points;

3. Filter effluent from each filter.

(e) pH monitoring equipment shall be provided for monitoring

1. Raw water;

2. Treated water;

3. Finished water.

(f) Chlorine residual indicating and recording monitors shall monitor the finished water leaving the plant.

(g) Filtration rates shall not exceed eight gallons per minute per square foot of filter area.

(h) Filters shall be of the dual media or multimedia type.

(i) The plant shall meet the following parameters for a 12-month period prior to applying for approval to conduct a high rate study and applying for an increase in the filtration rate.

1. The treatment facility shall meet the Area Wide Optimization Program goals as set forth in the latest revision of EPA's handbook: Optimizing Water Treatment Plant Performance Using the Composite Correction Program or as specified by the Department.

2. The water system shall not have exceeded any primary or secondary water quality standards within the past 12-month period.

3. The water system shall have no outstanding violations or major system deficiencies.

(j) The minimum detention time for the settling basins must be two hours with sludge removal and four hours without sludge removal. Basins equipped with tube settlers or plate settlers and continuous sludge removal do not have to meet the detention time requirement, but the flow rate through the tube or plate settlers cannot exceed the manufacturer's maximum recommended flow rate. A demonstration of the actual settling basin detention times must be completed along with the high rate filtration study.

(k) The detention times for the flash mix and flocculator basins will be waived.

(l) Water Treatment plants requesting high rate approval after December 31, 2005 must have a minimum of two treatment trains. These trains must be capable of independent operation from flocculation through filtration.

(m) Systems operating at filtration rates above four gpm/sf must meet the following additional requirements:

1. System must have 24 hour per day access to bacteriological analysis capabilities.

2. An annual evaluation of the raw water source shall be performed. This must include fecal coliform monitoring and an inventory of all discharges and activities which may impact the raw water quality available to the plant.

3. The system must analyze one sample per day from the water treatment plant’s effluent for the presence of coliform and E. coli if any result is coliform positive. Any positive sample must be reported to the Department within 24 hours. The Department may increase the system’s monthly bacteriological sampling requirements due to any positive result.

(n) Upon completion of the High Rate Study a report must be submitted to the Department for approval.

(o) Approval to operate at an increased filtration rate above two gpm per square foot of filter area can be revoked if any of the above conditions are not met or if the water system receives an unsatisfactory score on a Sanitary Survey Report.

Author: Edgar K. Hughes, Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
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January 22, 2008. **Amended:** Filed April 21, 2009; effective May 26, 2009.

335-7-6-.10 Disinfection.

(1) A disinfectant application rate must be provided to all filtered water to provide at least a one log Giardia lamblia cyst and a two log virus inactivation. This shall be demonstrated by providing a suitable contact time with a primary disinfectant. The acceptable primary disinfectants are chlorine, chlorine dioxide and Ultraviolet Light (UV). Chlorine is the preferred primary disinfectant. Chloramines may not be used as a primary disinfectant.

(a) Should chlorine be used as the primary disinfectant, a CT of at least 70 must be available or the system must demonstrate that a CT acceptable to the Department corresponding to the water characteristics and detention is available, but the chlorine residual entering the distribution system from each plant shall not be less than the level included on the facility's operating permit or less than 1.0 mg/L at any time.

(b) Approval from the Department must be obtained before using any disinfectant other than chlorine. Duplicate equipment may be required. A minimum CT for the disinfectant shall be provided in accordance with Departmental calculations and EPA guidance.

(c) Systems utilizing a primary disinfectant other than chlorine must add a secondary disinfectant to maintain disinfectant residuals in the distribution system. Acceptable secondary disinfectants are chlorine and/or chloramines. Chlorine is the preferred secondary disinfectant. If chlorine is used as a secondary disinfectant the minimum residual entering the distribution system from each treatment plant shall not be less than 1.0 mg/l at any time. Chloramines may be used as a secondary disinfectant only with written Departmental approval. The minimum chloramines residual entering the distribution system from each plant shall not be less than 2.0 mg/L at any time. Systems utilizing chloramines as a secondary disinfectant must revert to initial lead and copper monitoring as outlined in 335-7-11 for a minimum of three years.

(2) Any system that is proposing to change its primary disinfectant must submit to the department a description of the proposed change, a disinfection profile (graphically) for giardia lamblia and viruses, disinfection benchmark, and an analysis of how the proposed changes will affect the current level of disinfection.

(3) Failure to provide disinfection as required or correct a deficiency within 4 hours of occurrence results in a treatment technique violation requiring public notification within 14 days of occurrence. The Department shall be notified of all such deficiencies and resulting action no later than 48 hours of the occurrence of the deficiency.

(4) Any change to the disinfection practices which may affect the contact time must have prior written Departmental approval.
Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
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335-7-6-.11 Disinfection Profiling And Benchmarking.

(1) Systems must conduct disinfection profiling for all surface water sources and sources that have been designated as ground water under the influence of surface water that does not comply with one of the following must conduct disinfection profiling for up to three years beginning not later than March 16, 2000.

(a) The water system has conducted simultaneous monitoring of water in the distribution system for HAA5 and TTHM that meets the monitoring sample number and location requirements for TTHM. The arithmetic average of all results for the last four quarters of monitoring completed by March 16, 1999 is not greater than .064 mg/L for TTHM and not greater than .048 mg/L for HAA5.

(b) The water system has conducted monitoring in accordance with the Information Collection Rule (ICR) and the arithmetic average of all results for the last four quarters of monitoring for TTHM is not greater than .064 mg/L and monitoring for HAA5 is not greater than .048 mg/L.

(c) The water system confirms a minimum CT using chlorine of no less than 70 is available between the filter effluent and the first customer and submits graphs of filtered water turbidity and probability profiles that demonstrate that the maximum turbidity of water each day from each water treatment plant filter determined every fifteen minutes for the last 12 consecutive months is no greater than 0.1 NTU in 95% of all samples analyzed and no individual turbidity determined on water from any filter exceeds 0.3 NTU.

(2) Any system required to conduct a disinfection profile must daily, during peak hourly flow, for a period of 12 consecutive calendar months:

(a) Determine the temperature, pH and residual disinfectant concentration (C) of water at a point just before each disinfectant is added and at or before the first customer,

(b) Determine the disinfectant contact time (T) in each disinfection segment before the first customer,

(c) Determine the total CT (CT_{Total}) of water before the first customer by adding the individual CT determined for each disinfection treatment segment before the first customer,

(d) Calculate the total Giardia lamblia and virus inactivation ratio by dividing the calculated CT (CT_{calc}) by the CT required for 99.9% inactivation ($CT_{99.9}$) for each successive disinfection segment,

(e) Determine the total logs of Giardia lamblia and virus inactivation by multiplying the sum of the Giardia lamblia and virus inactivation ratios (CTcalc /$CT_{99.9}$) for each successive disinfection segment by 3 (3 x Sum (CTcalc /$CT_{99.9}$)), and

(f) Retain the disinfection profile data in graphic form for onsite review by the Department and/or for submittal to the Department for review if requested.

(3) Any system required to develop a disinfection profile that decides to make a significant change or modification to its disinfection practice must contact the Department prior to making such change. Significant changes or modifications to disinfection practice include changes to the point of disinfection; disinfectant(s) used in the treatment plant; the disinfection process; or any other modifications identified by the Department as a significant change to disinfection.

(4) Any system that is proposing to change or alter its disinfection practice must submit a description of the proposed change, the disinfection profile (graphically), disinfection benchmark and an analysis of how the proposed changes will affect the current level of disinfection.

(5) Benchmarking is the process of defining the lowest Giardia lamblia inactivation value.

(a) For systems with one year of profiling data the disinfection benchmark is the lowest of 12 monthly average Giardia lamblia inactivation values.

(b) For systems with more than one year of profiling data the disinfection benchmark is the average of the lowest monthly Giardia lamblia inactivation average value in each year divided by the number of years profile data is collected.

(6) When determining the Giardia lamblia or virus inactivation, systems must use a method approved by the Department or EPA.
Author: Edgar K. Hughes, Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
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335-7-6-.12 Chemicals Used In Water Treatment.

(1) Chemicals used in water treatment must be approved by the Department prior to use. Water Systems shall determine that the chemical or substance to be added and the proposed application rate meets the ANSI/NSF standard 60 or 61. Only products meeting these standards shall be used by supplier of water and certification that such a product meets these standards must be determined through evaluation by a program certified by the American National Standards Institute. Water Systems shall provide a list of the type, name, and manufacturer, and certification document requesting departmental approval prior to use of the substance or chemical. Water treatment chemicals containing acrylamide or epichlorohydrin are prohibited from use in water treatment plants unless the system provides annually a written certification to the department that when acrylamide and/or epichlorohydrin are used to treat water, the combination of dose and monomer level does not exceed the following levels: acrylamide - 0.05% dosed at 1ppm or equivalent. Epichlorohydrin - 0.01% dosed at 20 ppm or equivalent.

(2) Chemicals shall be stored in packages or containers as received or otherwise their containers shall be labeled to indicate the name of the chemical. Acid storage tanks must be vented to the outside atmosphere in a separate vent stack.

(3) Chemicals shall be controlled to prevent contamination with other chemicals and to eliminate any dangerous mixing of chemicals.
Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: May 23, 1977. **Repealed and Readopted:** January 4, 1989; October 31, 1990. **Revised:** September 23, 1992; effective November 9, 1992. (Rule was renumbered from .10 to .18, as per

certification filed December 21, 1998; effective January 25, 1999, with no changes made to the rule.) **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005.

Ed. Note: Rule 335-7-6-.19 was previously Rule 335-7-6-.18 per certification filed May 2, 2000; effective June 6, 2000.

335-7-6-.13 Treatment Process Equipment.

(1) Existing treatment plants must comply with these requirements by December 31, 2007.

(2) Where a treatment process is necessary for the production of safe drinking water, such as chlorination or coagulation, a minimum of two sets of chemical feeders shall be provided. A standby unit or combination of units of sufficient capacity shall be made available to replace the largest unit during shutdowns. The capacity and design must comply with the following:

(a) Feeders shall be able to deliver the necessary amounts of treatment chemical accurately at all times.

(b) Feeders must be designed to prevent treatment chemicals from being siphoned into the water supply.

(c) Service water supply lines must be equipped with backflow prevention devices or an air gap must be provided between the supply line and solution tank.

(d) Feeders and supply lines must be resistant to the aggressiveness of the chemical solution.

(e) A means for calibration of the amount of chemical being fed should be available for each individual chemical feeder.

(f) Chlorine feed systems must be capable of accurately determining the amount of chemical being fed at each individual point of application.

Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: May 23, 1977. **Repealed and Readopted:** January 4, 1989; October 31, 1990; effective December 5, 1990. (Rule was renumbered from .11 to .19, as per certification filed December 21, 1998; effective January 25, 1999, with no changes made to the rule.) **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005.

Ed. Note: Rule 335-7-6-.20 was previously Rule 335-7-6-.19 per certification filed May 2, 2000; effective June 6, 2000.

335-7-6-.14 Enhanced Coagulation.

Systems using surface water or groundwater under the direct influence of surface water shall operate with enhanced coagulation to achieve the TOC percent removal levels specified in this section unless the system meets at least one of the alternative compliance criteria listed below.

(a) Systems that meet any of the following criteria do not have to demonstrate that the system has achieved TOC removal percentages in this section.

1. The system's raw water TOC running annual average, calculated quarterly, is less than 2.0 mg/L.

2. The system's treated water TOC running annual average, calculated quarterly, is less than 2.0 mg/L.

3. The treatment plant's raw water TOC annual average, calculated quarterly, is less than 4.0 mg/L, the raw water alkalinity annual average, calculated quarterly, is greater than 60 mg/L (as CaCO3), and either the TTHM and HAA5 annual averages for the treatment plant’s sample sites are no greater than 0.040 mg/L and 0.030 mg/L, respectively; or prior to January 1, 2001, the system has made a clear and irrevocable financial commitment not later than January 1, 2001 to use technologies that will limit the levels of TTHMs and HAA5 to no more than 0.040 mg/L and 0.030 mg/L, respectively. The water system must submit evidence of a clear and irrevocable financial commitment, in addition to a schedule containing milestones and periodic progress reports for installation and operation of appropriate technologies, to the Department for approval not later than January 1, 2001. These technologies must be installed and operating not later than June 30, 2005. Failure to install and operate these technologies by the date in the approved schedule will constitute a violation.

4. The system’s TTHM and HAA5 annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively, and the system uses only chlorine for primary disinfection and maintenance of a residual in the distribution system.

5. The treatment plant’s raw water SUVA annual average, measured monthly and calculated quarterly, is less than or equal to 2.0 L/mg-m.

6. The treatment plant's finished water SUVA annual average, measured monthly and calculated quarterly, is less than or equal to 2.0 L/mg-m.

(b) Each water treatment plant in the system must achieve the percent reduction of TOC specified below (Step 1) between the raw water and the combined filter effluent, unless the Department approves the system's request for alternate minimum TOC removal (Step 2).

1. Required Step 1 TOC reductions, indicated in the following table, are based upon specified raw water parameters.

Step 1 required removal of TOC by enhanced coagulation for systems using conventional treatment:

Raw-Water TOC, mg/L	**Source Water alkalinity, mg/L as CaCO3**		
	0-60 %	> 60-120 %	>120 %
>2.0-4.0	35.0	25.0	15.0
>4.0-8.0	45.0	35.0	25.0
>8.0	50.0	40.0	30.0

(c) Each water treatment plant that cannot achieve the Step 1 TOC removals due to water quality parameters or operational constraints must apply to the Department, within three months of failure to achieve the Step 1 TOC removals, for approval of alternative minimum Step 2 TOC removals. If the Department approves the alternative minimum Step 2 TOC removals, Step 2 requirements can be made retroactive for the purposes of determining compliance. Until alternate minimum Step 2 TOC removals are approved, the system must achieve the Step 1 TOC removals.

(d) Applications made to the Department for approval of alternative minimum Step 2 TOC removal must include, as a minimum, results of bench- or pilot-scale testing conducted under the requirements of this rule and used to determine the alternate enhanced coagulation level.

1. Alternate enhanced coagulation level is defined as coagulation at a coagulant dose and pH as determined by the method described in this section such that an incremental addition of 10 mg/L of alum (as aluminum) or an equivalent amount of another coagulant (if a coagulant other than alum is used) results in a TOC removal of < 0.3 mg/L. The percent removal of TOC at this point on the "TOC removal versus coagulant dose" curve is then defined as the minimum TOC removal required for the system. Once approved by the Department, this minimum requirement supersedes the minimum Step 1 TOC removal. This requirement will be effective until such time as a new

value is approved based on the results of a new bench and pilot scale test. Failure to achieve an alternate minimum TOC removal is a violation.

2. Bench or pilot-scale testing of enhanced coagulation must be conducted by using representative water samples and adding 10 mg/L increments of alum (as aluminum) or equivalent amounts of an alternate coagulant until the pH is reduced to a level less than or equal to the enhanced coagulation Step 2 target pH indicated in the following table:

Alkalinity (mg/L as CaCO3)	**Target pH**
0-60	5.5
>60-120	6.3
>120-240	7.0
>240	7.5

3. For waters with alkalinities of less than 60 mg/L for which addition of small amounts of alum or the equivalent addition of an alternate coagulant drives the pH below 5.5 before significant TOC removal occurs, the system must add necessary chemicals to maintain the pH between 5.3 and 5.7 until the TOC removal of 0.3 mg/L per 10 mg/L alum added (as aluminum) or equivalent addition of an alternate coagulant is reached.

4. The system may operate at any coagulant dose or pH necessary to achieve the approved minimum TOC percent removal.

5. If the TOC removal is consistently less than 0.3 mg/L of TOC per 10 mg/L of incremental alum dose (as aluminum) at all dosages of alum or the equivalent addition of an alternate coagulant, the water is deemed to contain TOC not amenable to enhanced coagulation. The system may then apply to the State for a waiver of enhanced coagulation requirements.

(e) Additional alternative compliance criteria for softening systems. Systems practicing enhanced softening that cannot achieve the TOC removals required by paragraph (2) of this rule may use one of the following alternative compliance criteria in lieu of complying with paragraph (2) of this rule. Systems must still comply with monitoring requirements in rule 335-7-2-.11.

1. Softening that results in lowering the treated water alkalinity to less than 60 mg/L (as CaCO3), measured monthly according to rule 335-7-2-.02 and calculated quarterly as a running annual average.

2. Softening that results in removing at least 10 mg/L of magnesium hardness (as CaCO3), measured monthly according to rule 335-7-2-.02 and calculated quarterly as a running annual average.

(f) Systems must calculate compliance quarterly, beginning after the system has collected 12 consecutive months of data, by determining an annual average using the following method:

1. For each treatment plant use the following method to determine the actual TOC percent removal and the required TOC percent removal for each month. Divide the actual TOC percent removal by the required TOC percent removal. Determine compliance by averaging these values for the previous twelve months. If this value is less than 1.00, the system is in non-compliance with TOC percent removal requirements.

2. In any month that the treatment plant's treated or raw water TOC level is less than 2.0 mg/L, the system may assign a monthly value of 1.0 when calculating compliance with TOC removal requirements.

3. In any month that the treatment plant's treated or raw water SUVA is less than or equal to 2.0 L/mg-m, the system may assign a monthly value of 1.0 when calculating compliance with TOC removal requirements.

Author: Edgar K. Hughes, Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: New Rule: Filed May 2, 2000; effective June 6, 2000. **Amended:** Filed December 24, 2003; effective January 28, 2004. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005. **Amended:** Filed December 18, 2007; Effective January 22, 2008.

335-7-6-.15 Lighting And Power Requirements.

(1) Proper illumination shall be available to allow evaluation of treatment processes at the water treatment plant at all times.

(2) New community treatment facilities permitted for construction after December 31, 2005 shall have sufficient auxiliary power capacity available to operate essential equipment at the plant.

(3) All community surface water treatment facilities shall have sufficient auxiliary power available to operate essential equipment no later than December 31, 2010.

(a) Essential equipment includes, but is not limited to, raw water pumps, laboratory testing equipment, monitoring

equipment, and high service pumps needed to meet expected customer demand for finished drinking water during emergency conditions.

(b) If a water system owns more than one water treatment facility, it can designate one facility as the primary facility and this facility must meet the requirements of this paragraph and be capable of supplying the entire distribution system during emergency conditions.

(c) The auxiliary power requirement can be met by having an on-site generator or an equivalent design approved by the Department.

Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: May 23, 1977. Repealed and Readopted; January 4, 1989; October 31, 1990; effective December 5, 1990. (Rule was renumbered from .12 to .20, as per certification filed December 21, 1998; effective January 25, 1999, with no changes made to the rule.) **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005. **Amended:** Filed December 14, 2010; effective January 18, 2011. **Amended:** Filed August 21, 2012; effective September 25, 2012.

Ed. Note: Rule 335-7-6-.22 was previously Rule 335-7-6-.20 per certification filed May 2, 2000; effective June 6, 2000.

335-7-6-.16 Treatment Plant Security Requirements.

Each intake structure and treatment plant must have adequate security to prevent the entrance of unauthorized personnel. As a minimum each intake structure and treatment plant should have a perimeter fence and locks on all exterior entrances.

Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **Repealed and Readopted:** January 4, 1989; October 31, 1990; effective January 2, 1996. (Rule was renumbered from .08 to .16, as per certification filed December 21, 1998; effective January 25, 1999, with no changes made to the rule.) **Amended:** Filed May 2, 2000; effective June 6, 2000. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005.

335-7-6-.17 Laboratory Facilities.

All treatment plants permitted for construction after December 31, 2005 must have laboratory facilities as specified in the following:

(a) General Requirements:

1. Laboratory equipment and facilities shall be compatible with the raw water source, intended design of the treatment plant, daily monitoring and the complexity of the treatment process involved.

2. Recognized laboratory procedures must be utilized and the testing equipment shall be acceptable to the Department.

3. Laboratory facilities should not be used for activities and/or purposes that are not pertinent to the operation of the plant or in the execution of the duties of the operator and/or the laboratory analyst.

(b) Laboratory Space and Facilities

1. Laboratory facilities shall be located in a separate room from all non laboratory activities.

2. Sufficient bench space, adequate ventilation, adequate lighting, storage room, laboratory sink and auxiliary facilities shall be provided.

3. If a treatment plant has a certified bacteriological laboratory it shall have adequate counter space and shall be located in a separate area from the water quality laboratory.

(c) Sample taps shall be provided so that water samples can be obtained from each water source and from appropriate locations in each treatment unit process. Taps shall be consistent with sampling needs and not be of petcock type. Sample lines and pumps shall be sized to minimize time between point of sampling and point of sample collection.

Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: New Rule: Filed May 2, 2000; effective June 6, 2000. **Amended:** Filed April 25, 2003; effective May 30, 2003. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005.

335-7-6-.18 Filter Backwash Recycling.

All systems that employ conventional filtration or direct filtration treatment and that recycle spent filter backwash water, thickener supernatant, or liquids from dewatering processes must meet the following requirements:

(a) Reporting. A system must notify the state in writing by December 8, 2003, if the system recycles spent filter backwash water, thickener supernatant, or liquids from dewatering processes. This notification must include, at a minimum:

1. A plant schematic showing the origin of all recycled flows, the hydraulic conveyance used to transport them and the location where they are reintroduced back into the treatment plant. The schematic shall also show all treatment processes and all chemical addition points.

2. Typical recycle flow in gallons per minute (gpm), the highest observed plant flow experienced in the previous year (gpm), design flow for the treatment plant (gpm), permitted operating capacity for the plant.

3. Documentation proving the system can recycle spent filter backwash water, thickener supernatant, or liquids from dewatering processes and continuously produce water that meets the requirements of Rule 335-7-6-.04.

(b) Treatment technique requirement. Any system that recycles spent filter backwash water, thickener supernatant, or liquids from dewatering processes must meet the following minimum treatment requirements:

1. All recycle flows must undergo independent clarification before being reintroduced to the treatment processes.

2. All recycle flows must enter the main raw water supply before this combined water source enters the plant’s first treatment process.

3. Equipment must be installed to measure turbidity found in recycle flows before being introduced to the raw water supply, prior to the plant’s first treatment process.

4. All capital improvements required to modify recycle processes, to meet these requirements, must be completed no later than June 8, 2006.

(c) Recordkeeping. The system must collect and retain on file, for a period of no less than 5 years, the following recycle flow information for review and evaluation by the Department beginning June 8, 2004:

1. Copy of the recycle notification and information submitted to the state under paragraph (a) of this section.

2. List of all recycle flows and the frequency with which they are returned.

3. Average and maximum backwash flow rate through the filters and the average and maximum duration of the filter backwash process in minutes.

4. Typical filter run length and a written summary of how filter run length is determined.

5. The type of treatment provided for the recycle flow.

6. Data on the physical dimensions of the equalization and/or treatment units, typical and maximum hydraulic loading rates, type of treatment chemicals used, average dose, frequency of use, and frequency at which solids are removed.

Author: Edgar K. Hughes
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: New Rule: Filed April 25, 2003; effective May 30, 2003. **Repealed and New Rule:** Filed November 7, 2005; effective December 12, 2005.

335-7-6-.19 Cryptosporidium Treatment Requirements.

Filtered systems must provide the level of additional treatment for *Cryptosporidium* specified in the following table based upon their bin classification as determined under rule 335-7-2-.17.

(a) Additional treatment requirement for *Cryptosporidium* based upon bin classification:

Additional Treatment Requirements for *Cryptosporidium*				
Bin Classification	The system is in full compliance with 335-7-6-2, then the additional treatment requirements are…			
	Conventional filtration treatment (including softening)	Direct Filtration	Slow sand or diatomaceous earth filtration	Alternative filtration technologies
Bin 1	No additional treatment	No additional treatment	No additional treatment	No additional treatment
Bin 2	1-log treatment	1.5-log treatment	1-log treatment	(1)
Bin 3	2-log treatment	2.5-log treatment	2-log treatment	(2)
Bin 4	2.5-log treatment	3-log treatment	2.5-log treatment	(3)

(1) As determined by the Department such that the total *Cryptosporidium* removal and inactivation is at least 4.0-log.

(2) As determined by the Department such that the total *Cryptosporidium* removal and inactivation is at least 5.0-1log.

(3) As determined by the Department such that the total *Cryptosporidium* removal and inactivation is at least 5.5-1log.

(b) Systems must use one or more of the treatment and management options listed in rule 335-7-6-.21 to comply with the additional *Cryptosporidium* treatment required in subparagraph (a) of this rule.

(c) Systems classified in Bin 3 or Bin 4 must achieve at least 1-1log of the additional *Cryptosporidium* treatment required under this section using either one or a combination of the following: bag filters, bank filtration, cartridge filters, chlorine dioxide, membranes, ozone, or UV, as described in rule 335-7-6-.22.

(d) Failure by a system in any month to achieve treatment credit by meeting the criteria in rules 335-7-6-.22 through 335-7-6-.26 for microbial toolbox options that is at least equal to the level of treatment required in subparagraph (a) of this rule is a violation of the treatment technique requirement.

(e) If the Department determines during a sanitary survey or an equivalent source water assessment that after a system completed the monitoring conducted under rule 335-7-2-.17, significant changes occurred in the system's watershed that could lead to increase contamination of the source water by *Cryptosporidium*, the system must take actions specified by the Department to address the contamination. These actions may include additional source water monitoring and/or implementation of microbial toolbox options listed in rule 335-7-6-.21.

Author: Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **New Rule:** Filed December 18, 2007; effective January 22, 2008.

335-7-6-.20 Cryptosporidium Treatment Requirement Schedule.

Following bin classification, systems must provide the level of treatment for *Cryptosporidium* required under rule 335-7-6-.19 according to the schedule below:

(a) *Cryptosporidium* treatment compliance dates.

***Cryptosporidium* Treatment Compliance Dates**

System Population	Treatment insalllation deadline a*
At least 100,000	April 1, 2012
50,000 to 99,999	October 1, 2012
10,000 to 49,999	October 1, 2013
< 10,000	October 1, 2014

[a] The Department may allow up to an additional two years for complying with the treatment requirement for systems making capital improvements.

(b) If the bin classification for a system changes following any round of source water monitoring, the system must provide the level of treatment for *Cryptosporidium* required under rule 335-7-6-.19 on a schedule approved by the Department.
Author: Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **New Rule:** Filed December 18, 2007; effective January 22, 2008.

335-7-6-.21 Microbial Toolbox Options.

Systems receive treatment credits listed in the following table by meeting the conditions for microbial toolbox options described in rules 335-7-6-.22 through 335-7-6-.26. Systems apply these treatment credits to meet the treatment requirements in rule 335-7-6-.19.

(a) Microbial Toolbox Summary Table: Options, Treatment Credits and Criteria:

Microbial Toolbox Summary	
Toolbox Option	***Cryptosporidium* treatment credit with design and implementation criteria**
Source Protection and Management Toolbox Options (For specific criteria, see rule 335-7-6-.22)	
Watershed control program	0.5-log credit for Departmental approved program comprising required elements, annual program status report to the Department, and regular watershed survey.
Alternate source/intake management	No prescribed credit. Systems may conduct simultaneous monitoring for treatment bin classification at alternative

	intake locations or under alternative intake management strategies

Pre-Filtration Toolbox Options (For specific criteria, see rule 335-7-6-.23)	
Presedimentation basin with coagulation	0.5-log credit during any month that Presedimentation basins achieve a monthly mean reduction of 0.5-log or greater in turbidity or alternative Department-approved performance criteria. To be eligible, basins must be operated continuously with coagulant addition and all plant flow must pass through basins.

Microbial Toolbox Summary	
Two-stage lime softening	0.5-log credit for two-stage softening where chemical addition and hardness precipitation occur in both stages. All plant flow must pass through both stages. Single-stage softening is credited as equivalent to conventional treatment.
Bank Filtration	0.5-log credit for 25-foot setback; 1.0-log credit for 50-foot setback; aquifer must be unconsolidated sand containing at least 10 percent fines; average turbidity in wells must be less than 1 NTU. Systems using wells followed by filtration when conducting source water monitoring must sample the well to determine bin classification and are not eligible for additional credit

Treatment Performance Toolbox Options (For specific criteria, see rule 335-7-6-.24)	
Combined filter performance	0.5-log credit for combined filter effluent turbidity less than or equal to 0.15 NTU in at least 95 percent of measurements each month.
Individual filter performance	0.5-log credit (in addition to 0.5-log combined filter performance credit) if individual filter effluent turbidity is less than or equal to 0.15 NTU in at least 95 percent of samples each month in each filter and is never greater than 0.3 NTU in two consecutive measurements in any filter.
Demonstration of performance	Credit awarded to unit process or treatment train based on a demonstration to the Department with a Department-approved protocol.

Additional Filtration Toolbox Options (For specific criteria, see rule 335-7-6-.25)

Bag or cartridge filters (individual filters)	Up to 2-log credit based on the removal efficiency demonstrated during challenge testing with a 1.0-log factor of safety.
Bag or cartridge filters (in series)	Up to 2.5-log credit based on the removal efficiency demonstrated during challenge testing with a 0.5-log factor of safety.
Membrane filtration	Log credit equivalent to removal efficiency demonstrated in challenge test for device if supported by direct integrity testing.
Second stage filtration	0.5-log credit for second separate granular media filtration stage if treatment train includes coagulation prior to first filter.
Slow sand filters	2.5-log credit as a secondary filtration step; 3.0-log credit as a primary filtration process. No prior chlorination for either option.

Inactivation Toolbox Options (For specific criteria, see rule 335-7-6-.26)	
Chlorine Dioxide	Log credit based on measured CT in relation to CT table.
Ozone	Log credit based on measured CT in relation to CT table.
UV	Log credit based on validated UV dose in relation to UV dose table; reactor validation testing required to establish UV dose and associated operating conditions

Author: Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **New Rule:** Filed December 18, 2007; effective January 22, 2008.

335-7-6-.22 Source Toolbox Components.

(1) Watershed control program. Systems receive 0.5-log *Cryptosporidium* treatment credit for implementing a watershed control program that meets the following requirements:

(a) Systems that intend to apply for the watershed control program credit must notify the Department of this intent no later than two years prior to the treatment compliance date applicable to the system in rule 335-7-6-.20.

(b) Systems must submit to the Department a proposed watershed control plan no later than one year before the applicable treatment compliance date in rule 335-7-6-.20. The Department must approve the watershed control plan for the system to receive watershed control program treatment credit. The watershed control plan must include the following elements:

1. Identification of an "area of influence" outside of which the likelihood of *Cryptosporidium* or fecal contamination affecting the treatment plant intake is not significant. This is the area to be evaluated in future watershed surveys under subparagraph (1)(e)2. of this rule.

2. Identification of both potential and actual sources of *Cryptosporidium* contamination and an assessment of the relative impact of these sources on the system's source water quality.

3. An analysis of the effectiveness and feasibility of control measures that could reduce *Cryptosporidium* loading from sources of contamination to the system's source water.

4. A statement of goals and specific actions the system will undertake to reduce source water *Cryptosporidium* levels. The plan must explain how the actions are expected to contribute to specific goals, identify watershed partners and their roles, identify resource requirements and commitments, and include a schedule for plan implementation with deadlines for completing specific actions identified in the plan.

(c) Systems with existing watershed control programs (i.e., programs in place before January 5, 2006, are eligible to seek this credit. Their watershed control plans must meet the criteria in subparagraph (1)(b) of this rule and must specify ongoing and future actions that will reduce source water *Cryptosporidium* levels.

(d) If the Department does not respond to a system regarding approval of a watershed control plan submitted under this section and the system meets the other requirements of this section, the watershed control program will be considered approved and 0.5-1log *Cryptosporidium* treatment credit will be awarded unless and until the Department subsequently withdraws such approval.

(e) Systems must complete the following actions to maintain the 0.5-1og credit:

1. Submit an annual watershed control program status report to the Department. The annual watershed control program status report must describe the system's implementation of the approved plan and assess the adequacy of the plan to meet its goals. It must explain how the system is addressing any shortcomings in plan implementation, including those previously identified by the Department or as the results of the watershed survey conducted under subparagraph (1)(e)2. of this rule. It must also describe any significant changes that have occurred in the watershed since the last watershed sanitary survey. If a system determines during implementation that making a significant change to its approved watershed control program is necessary, the system must notify the Department prior to making any such changes. If any change is likely to reduce the level of source water protection, the system must also list in its notification the actions the system will take to mitigate this effect.

2. Undergo a watershed sanitary survey every three years and submit the survey report to the Department. The survey must be conducted according to Department guidelines and by persons approved by the Department.

a. The watershed sanitary survey must meet the following criteria: encompass the region identified in the Department-approved watershed control plan as the area of influence; assess the implementation of actions to reduce source water *Cryptosporidium* levels; and identify any significant new sources of *Cryptosporidium*.

b. If the Department determines that significant changes may have occurred in the watershed since the previous watershed sanitary survey, systems must undergo another watershed sanitary survey by a date established by the Department, which may be earlier than the regular date in subparagraph (1)(e)2. of this rule.

c. The system must make the watershed control plan, annual status reports, and watershed sanitary survey reports available to the public upon request. These documents must be in a plain language style and include criteria by which to evaluate the success of the program in achieving plan goals. The Department may approve systems to withhold from the public portions of the annual status report, watershed

control plan, and watershed sanitary survey based on water supply security considerations.

(f) If the Department determines that a system is not carrying out the approved watershed control plan, the Department may withdraw the watershed control program treatment credit.

(2) Alternative source.

(a) A system may conduct source water monitoring that reflects a different intake location (either in the same source or for an alternate source) or a different procedure for the timing or level of withdrawal from the source (alternative source monitoring). If approved by the Department, a system may determine its bin classification under rule 335-7-2-.17 based on the alternative source monitoring results.

(b) If systems conduct alternative source monitoring under subparagraph (2)(a) of this rule, systems must also monitor their current plant intake concurrently as described rule 335-7-2-.17.

(c) Alternative source monitoring under subparagraph (2)(a) of this rule must meet the requirements for source water monitoring to determine bin classification, as described in rule 335-7-2-.17. Systems must report the alternative source monitoring results to the Department, along with supporting information documenting the operating conditions under which the samples were collected.

(d) If a system determines its bin classification under rule 335-7-2-.17 using alternative source monitoring results that reflect a different intake location or different procedure for managing the timing or level of withdrawal from the source, the system must relocate the intake or permanently adopt the withdrawal procedure, as applicable, no later than the applicable treatment compliance date in rule 335-7-6-20.

Author: Dennis D. Harrison
Statutory Authority: Code of Ala. 1975, §§22-23-33, 22-23-49, 22-22A-5, 22-22A-6.
History: **New Rule:** Filed December 18, 2007; effective January 22, 2008.

335-7-6-.23 **Pre-Filtration Treatment Toolbox Components.**

(1) Presedimentation. Systems receive 0.5-1log *Cryptosporidium* treatment credit for a presedimentation basin during any month the process meets the following criteria:

(a) The presedimentation basin must be in continuous operation and must treat the entire plant flow taken from a surface

water or ground water under the direct influence of surface water source.

(b) The system must continuously add a coagulant to the presedimentation basin.

(c) The presedimentation basin must achieve the following performance criteria:

1. Demonstrate at least 0.5-1og mean reduction in influent turbidity. This reduction must be determined using the daily average turbidity measurements taken every four hours in the presedimentation process influent and effluent and must be calculated as follows: log (monthly mean of daily influent 10turbidity) - log (monthly mean of daily effluent turbidity). 10

2. Comply with Department-approved performance criteria that demonstrate at least 0.5-1og mean removal of micron sized particulate material through the presedimentation process.

(2) Two-stage lime softening. Systems receive an additional 0.5-1og *Cryptosporidium* treatment credit for a two-stage lime softening plant if chemical addition and hardness precipitation occur in two separate and sequential softening stages prior to filtration. Both softening stages must treat the entire plant flow taken from a surface water or ground water under the direct influence of surface water source.

(3) Bank filtration. Systems receive *Cryptosporidium* treatment credit for bank filtration that serves as pretreatment to a filtration plant by meeting the following criteria. Systems using bank filtration when they began source water monitoring under rule 335-7-2-.17 must collect samples as described and are not eligible for this credit.

(a) Wells with a ground water flow path of at least 25 feet receive 0.5-1og treatment credit; wells with a ground water flow path of at least 50 feet receive 1.0-1og treatment credit. The ground water flow path must be determined as specified in subparagraph (3)(d) of this rule.

(b) Only wells in granular aquifers are eligible for treatment credit. Granular aquifers are those comprised of sand, clay, silt, rock fragments, pebbles or larger particles, and minor cement. A system must characterize the aquifer and demonstrate that in at least 90 percent of the core length, grains less than 1.0 mm in diameter constitute at least 10 percent of the core material.

(c) Only horizontal and vertical wells are eligible for treatment credit.

(d) For vertical wells, the ground water flow path is the measured distance from the edge of the surface water body under high flow conditions (determined by the 100 year floodplain elevation boundary or by the floodway, as defined in Federal Emergency Management Agency flood hazard maps) to the well screen. For horizontal wells, the ground water flow path is the measured distance from the bed of the river under normal flow conditions to the closest horizontal well lateral screen.

(e) Systems must monitor each wellhead for turbidity at least once every four hours while the bank filtration process is in operation. If monthly average turbidity levels, based on daily maximum values in the well, exceed 1 NTU, the system must report this result to the Department and conduct an assessment within 30 days to determine the cause of the high turbidity levels in the well. If the Department determines that microbial removal has been compromised, the Department may revoke treatment credit until the system implements corrective actions approved by the Department to remediate the problem.

(f) Springs and infiltration galleries are not eligible for treatment credit under this section, but are eligible for credit under rule 335-7-6-.24.

(g) Bank filtration demonstration of performance. The Department may approve *Cryptosporidium* treatment credit for bank filtration based on a demonstration of performance study that meets the following criteria. This treatment credit may be greater than 1.0-1og and may be awarded to bank filtration that does not meet the criteria in subparagraphs (3)(a) – (e) of this rule.

1. The study must follow a Department-approved protocol and must involve the collection of data on the removal of *Cryptosporidium* or a surrogate for *Cryptosporidium* and related hydrogeologic and water quality parameters during the full range of operating conditions.

2. The study must include sampling both from the production well(s) and from monitoring wells that are screened and located along the shortest flow path between the surface water source and the production well(s).

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335-7-6-.24 Treatment Performance Toolbox Components.

(1) Combined filter performance. Systems using conventional filtration treatment or direct filtration treatment receive an additional 0.5-1log *Cryptosporidium* treatment credit during any month the system meets the criteria in this paragraph. Combined filter effluent (CFE) turbidity must be less than or equal to 0.15 NTU in at least 95 percent of the measurements. Turbidity must be measured using an EPA approved method and must be measured every 15 minutes that the water treatment plant is in operation.

(2) Individual filter performance. Systems using conventional filtration treatment or direct filtration treatment receive 0.5-1log *Cryptosporidium* treatment credit, which can be in addition to the 0.5-1log credit under paragraph (1) of this section, during any month the system meets the criteria in this paragraph. Compliance with these criteria must be based on individual filter turbidity monitoring as described in rule 335-7-2-.06.

(a) The filtered water turbidity for each individual filter must be less than or equal to 0.15 NTU in at least 95 percent of the measurements recorded each month.

(b) No individual filter may have a measured turbidity greater than 0.3 NTU in two consecutive measurements taken 15 minutes apart.

(c) Any system that has received treatment credit for individual filter performance and fails to meet the requirements of subparagraph (2)(a) or (b) of this rule during any month does not receive a treatment technique violation under rule 335-7-2-.06 if the Department determines the following:

1. The failure was due to unusual and short-term circumstances that could not reasonably be prevented through optimizing treatment plant design, operation, and maintenance.

2. The system has experienced no more than two such failures in any twelve month period.

3. Any system that that has two such failures in any 12 month period must complete a self assessment according to EPA's handbook: Optimizing Water Treatment Plant Performance Using the Composite Correction Program or as specified by the Department. The report must be submitted to the Department within 90 days of the second occurrence.

(3) Demonstration of performance. The Department may approve *Cryptosporidium* treatment credit for drinking water treatment processes based on a demonstration of performance study that meets the criteria in this paragraph. This treatment credit may be greater than or less than the prescribed treatment credits in this chapter and may be awarded to treatment processes that do not meet the criteria for the prescribed credits.

(a) Systems cannot receive the prescribed treatment credit for any toolbox box option in this chapter if that toolbox option is included in a demonstration of performance study for which treatment credit is awarded under this paragraph.

(b) The demonstration of performance study must follow a Department-approved protocol and must demonstrate the level of *Cryptosporidium* reduction the treatment process will achieve under the full range of expected operating conditions for the system.

(c) Approval by the Department must be in writing and may include monitoring and treatment performance criteria that the system must demonstrate and report on an ongoing basis to remain eligible for the treatment credit. The Department may designate such criteria where necessary to verify that the conditions under which the demonstration of performance credit was approved are maintained during routine operation.

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335-7-6-.25 Additional Filtration Toolbox Components.

(1) Bag and cartridge filters. Systems receive *Cryptosporidium* treatment credit of up to 2.0-1log for individual bag or cartridge filters and up to 2.5-1log for bag or cartridge filters operated in series by meeting the following criteria. To be eligible for this credit, systems must report the results of challenge testing that meets the requirements of subparagraphs (1)(b) through (i) of this rule to the Department. The filters must treat the entire plant flow taken from a surface water or ground water under the influence of surface water source.

(a) The *Cryptosporidium* treatment credit awarded to bag or cartridge filters must be based on the removal efficiency demonstrated during challenge testing that is conducted according to the criteria in subparagraphs (1)(b) through (i) of this rule. A factor of safety equal to 1-1log for individual bag or cartridge filters and 0.5-1log for bag or cartridge filters in series must be applied to challenge testing results

to determine removal credit. Systems may use results from challenge testing conducted prior to January 5, 2006 if the prior testing was consistent with the criteria specified in subparagraphs (1)(b) through (i) of this rule.

(b) Challenge testing must be performed on full-scale bag or cartridge filters, and the associated filter housing or pressure vessel, that are identical in material and construction to the filters and housings the system will use for removal of *Cryptosporidium*. Bag or cartridge filters must be challenge tested in the same configuration that the system will use, either as individual filters or as a series configuration of filters.

(c) Challenge testing must be conducted using *Cryptosporidium* or a surrogate that is removed no more efficiently than *Cryptosporidium*. The microorganism or surrogate used during challenge testing is referred to as the challenge particulate. The concentration of the challenge particulate must be determined using a method capable of discreetly quantifying the specific microorganism or surrogate used in the test; gross measurements such as turbidity may not be used.

(d) The maximum feed water concentration that can be used during a challenge test must be based on the detection limit of the challenge particulate in the filtrate (i.e., filtrate detection limit) and must be calculated using the following equation:

Maximum Feed Concentration = 1 x 10^4 x (Filtrate Detection Limit)

(e) Challenge testing must be conducted at the maximum design flow rate for the filter as specified by the manufacturer.

(f) Each filter evaluated must be tested for a duration sufficient to reach 100 percent of the terminal pressure drop, which establishes the maximum pressure drop under which the filter may be used to comply with the requirements of this subpart.

(g) Removal efficiency of a filter must be determined from the results of the challenge test and expressed in terms of log removal values using the following equation:

$$LRV = LOG_{10}(C_f) - LOG_{10}(C_p)$$

where

LRV = log removal value demonstrated during challenge testing;

C_f = the feed concentration measured during the challenge test; and

C_p = the filtrate concentration measured during the challenge test. In applying this equation, the same units must be used for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, then the term Cp must be set equal to the detection limit.

(h) Each filter tested must be challenged with the challenge particulate during three periods over the filtration cycle: within two hours of start-up of a new filter; when the pressure drop is between 45 and 55 percent of the terminal pressure drop; and at the end of the cycle after the pressure drop has reached 100 percent of the terminal pressure drop. An LRV must be calculated for each of these challenge periods for each filter tested. The LRV for the filter (LRVfilter) must be assigned the value of the minimum LRV observed during the three challenge periods for that filter.

(i) If fewer than 20 filters are tested, the overall removal efficiency for the filter product line must be set equal to the lowest LRV among the filters tested. If 20 or more filterfilters are tested, the overall removal efficiency for the filter product line must be set equal to the 10th percentile of the set of LRV values for the various filters tested. The percentile filteris defined by (i/(n+1)) where i is the rank of n individual data points ordered lowest to highest. If necessary, the 10th percentile may be calculated using linear interpolation.

(j) If a previously tested filter is modified in a manner that could change the removal efficiency of the filter product line, challenge testing to demonstrate the removal efficiency of the modified filter must be conducted and submitted to the Department.

(2) Membrane filtration.

(a) Systems receive *Cryptosporidium* treatment credit for membrane filtration that meets the criteria of this paragraph. Membrane cartridge filters that meet the definition of membrane filtration are eligible for this credit. The level of treatment credit a system receives is equal to the lower of the values determined under subparagraphs (2)(a)1. and 2. of this rule.

1. The removal efficiency demonstrated during challenge testing conducted under the conditions in subparagraph (2)(b) of this rule.

2. The maximum removal efficiency that can be verified through direct integrity testing used with the membrane filtration process under the conditions in subparagraph (2)(b)3. of this rule.

(b) Challenge Testing. The membrane used by the system must undergo challenge testing to evaluate removal efficiency, and the system must report the results of challenge testing to the Department. Challenge testing must be conducted according to the criteria in subparagraphs (2)(b)1. through 8. of this rule. Systems may use data from challenge testing conducted prior to January 5, 2006, if the prior testing was consistent with the criteria in subparagraphs (2)(b)1. through 8. of this rule.

1. Challenge testing must be conducted on either a full-scale membrane module, identical in material and construction to the membrane modules used in the system's treatment facility, or a smaller-scale membrane module, identical in material and similar in construction to the full-scale module. A module is defined as the smallest component of a membrane unit in which a specific membrane surface area is housed in a device with a filtrate outlet structure.

2. Challenge testing must be conducted using *Cryptosporidium* oocysts or a surrogate that is removed no more efficiently than *Cryptosporidium* oocysts. The organism or surrogate used during challenge testing is referred to as the challenge particulate. The concentration of the challenge particulate, in both the feed and filtrate water, must be determined using a method capable of discretely quantifying the specific challenge particulate used in the test; gross measurements such as turbidity may not be used.

3. The maximum feed water concentration that can be used during a challenge test is based on the detection limit of the challenge particulate in the filtrate and must be determined according to the following equation: Maximum Feed Concentration = 3.16 x 10^6 x (Filtrate Detection Limit)

4. Challenge testing must be conducted under representative hydraulic conditions at the maximum design flux and maximum design process recovery specified by the manufacturer for the membrane module. Flux is defined as the throughput of a pressure driven membrane process expressed as flow per unit of membrane area. Recovery is defined as the volumetric percent of feed water that is converted to filtrate over the course of an operating cycle uninterrupted by events such as chemical cleaning or a solids removal process (i.e., backwashing).

5. Removal efficiency of a membrane module must be calculated from the challenge test results and expressed as a log removal value according to the following equation:

$$LRV = LOG_{10}(C_f) - LOG_{10}(C_p)$$

where

LRV = log removal value demonstrated during the challenge test;

C_f = the feed concentration measured during the challenge test; and

C_p = the filtrate concentration measured during the challenge test. Equivalent units must be used for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, the term Cp is set equal to the detection limit for the purpose of calculating the LRV. An LRV must be calculated for each membrane module evaluated during the challenge test.

6. The removal efficiency of a membrane filtration process demonstrated during challenge testing must be expressed as a log removal value (LRVC-Test). If fewer than 20 modules are tested, then LRVC-Test is equal to the lowest of the representative LRVs among the modules tested. If 20 or more modules are tested, then LRVC-Test is equal to the 10th percentile of the representative LRVs among the modules tested. The percentile is defined by (i/(n+1)) where i is the rank of n individual data points ordered lowest to highest. If necessary, the 10th percentile may be calculated using linear interpolation.

7. The challenge test must establish a quality control release value (QCRV) for a nondestructive performance test that demonstrates the *Cryptosporidium* removal capability of the membrane filtration module. This performance test must be applied to each production membrane module used by the system that was not directly challenge tested in order to verify *Cryptosporidium* removal capability. Production modules that do not meet the established QCRV are not eligible for the treatment credit demonstrated during the challenge test.

8. If a previously tested membrane is modified in a manner that could change the removal efficiency of the membrane or the applicability of the non-destructive performance test and associated QCRV, additional

challenge testing to demonstrate the removal efficiency of, and determine a new QCRV for, the modified membrane must be conducted and submitted to the Department.

(c) Direct integrity testing. Systems must conduct direct integrity testing in a manner that demonstrates a removal efficiency equal to or greater than the removal credit awarded to the membrane filtration process and meets the requirements described in subparagraphs (2)(c)1. through 4. of this rule. A direct integrity test is defined as a physical test applied to a membrane unit in order to identify and isolate integrity breaches (i.e., one or more leaks that could result in contamination of the filtrate).

1. The direct integrity test must be independently applied to each membrane unit in service. A membrane unit is defined as a group of membrane modules that share common valving that allows the unit to be isolated from the rest of the system for the purpose of integrity testing or other maintenance.

2. The direct integrity method must have a resolution of 3 micrometers or less, where resolution is defined as the size of the smallest integrity breach that contributes to a response from the direct integrity test.

3. The direct integrity test must have a sensitivity sufficient to verify the log treatment credit awarded to the membrane filtration process by the Department, where sensitivity is defined as the maximum log removal value that can be reliably verified by a direct integrity test. Sensitivity must be determined using the following approach as applicable to the type of direct integrity test the system uses.

(i) For direct integrity tests that use an applied pressure or vacuum, the direct integrity test sensitivity must be calculated according to the following equation:

$$LRV_{DIT} = LOG_{10}(Q_p/(VCF \times Q_{breach}))$$

where

LRV_{DIT} = the sensitivity of the direct integrity test;

Q_p = total design filtrate flow from the membrane unit;

Q_{breach} = flow of water from an integrity breach associated with the smallest integrity test response that can be reliably measured; and

VCF = Volumetric Concentration Factor is the ratio of the suspended solids concentration on the high pressure side of the membrane relative to that in the feed water.

(ii) For direct integrity tests that use a particulate or molecular marker, the direct integrity test sensitivity must be calculated according to the following equation:

$$LRV_{DIT} = LOG_{10}(C_f) - LOG_{10}(C_p)$$

where

LRV_{DIT} = the sensitivity of the direct integrity test;

C_f = the typical feed concentration of the marker used in the test; and

C_p = the filtrate concentration of the marker from an integral membrane unit.

4. Systems must establish a control limit within the sensitivity limits of the direct integrity test that is indicative of an integral membrane unit capable of meeting the removal credit awarded by the Department.

5. If the result of a direct integrity test exceeds the control limit established under subparagraph (2)(c)4. of this rule, the system must remove the membrane unit from service. Systems must conduct a direct integrity test to verify any repairs, and may return the membrane unit to service only if the direct integrity test is within the established control limit.

6. Systems must conduct direct integrity testing on each membrane unit at a frequency of not less than once each day that the membrane unit is in operation. The Department may approve less frequent testing, based on demonstrated process reliability, the use of multiple barriers effective for *Cryptosporidium*, or reliable process safeguards.

(d) Indirect integrity monitoring. Systems must conduct continuous indirect integrity monitoring on each membrane unit

according to the following criteria. Indirect integrity monitoring is defined as monitoring some aspect of filtrate water quality that is indicative of the removal of particulate matter. A system that implements continuous direct integrity testing of membrane units in accordance with the criteria in subparagraphs (2)(c)1. through 4. of this rule is not subject to the requirements for continuous indirect integrity monitoring. Systems must submit a monthly report to the Department summarizing all continuous indirect integrity monitoring results triggering direct integrity testing and the corrective action that was taken in each case.

1. Unless the Department approves an alternative parameter, continuous indirect integrity monitoring must include continuous filtrate turbidity monitoring.

2. Continuous monitoring must be conducted at a frequency of no less than once every 15 minutes.

3. Continuous monitoring must be separately conducted on each membrane unit.

4. If indirect integrity monitoring includes turbidity and if the filtrate turbidity readings are above 0.15 NTU for a period greater than 15 minutes (i.e., two consecutive 15-minute readings above 0.15 NTU), direct integrity testing must immediately be performed on the associated membrane unit as specified in subparagraphs (2)(c)1. through 5. of this rule.

5. If indirect integrity monitoring includes a Department-approved alternative parameter and if the alternative parameter exceeds a Department-approved control limit for a period greater than 15 minutes, direct integrity testing must immediately be performed on the associated membrane units as specified in subparagraphs (2)(c)1. through 5. of this rule.

(3) Second stage filtration. Systems receive 0.5-1og *Cryptosporidium* treatment credit for a separate second stage of filtration that consists of sand, dual media, GAC, or other fine grain media following granular media filtration if the Department approves. To be eligible for this credit, the first stage of filtration must be preceded by a coagulation step and both filtration stages must treat the entire plant flow taken from a surface water or GWUDI source. A cap, such as GAC, on a single stage of filtration is not eligible for this credit. The Department must approve the treatment credit based on an assessment of the design characteristics of the filtration process.

(4) Slow sand filtration (as secondary filter). Systems are eligible to receive 2.5-1og *Cryptosporidium* treatment credit for a

slow sand filtration process that follows a separate stage of filtration if both filtration stages treat entire plant flow taken from a surface water or GWUDI source and no disinfectant residual is present in the influent water to the slow sand filtration process. The Department must approve the treatment credit based on an assessment of the design characteristics of the filtration process. This paragraph does not apply to treatment credit awarded to slow sand filtration used as a primary filtration process.
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335-7-6-.26 Inactivation Toolbox Components.

(1) Calculation of CT values.

(a) CT is the product of the disinfectant contact time (T, in minutes) and disinfectant concentration (C, in milligrams per liter). Systems with treatment credit for chlorine dioxide or ozone under paragraph (2) or (3) of this section must calculate CT at least once each day, with both C and T measured during peak hourly flow using EPA approved analytical methods.

(b) Systems with several disinfection segments in sequence may calculate CT for each segment, where a disinfection segment is defined as a treatment unit process with a measurable disinfectant residual level and a liquid volume. Under this approach, systems must add the Cryptosporidium CT values in each segment to determine the total CT for the treatment plant.

(2) CT values for chlorine dioxide and ozone.

(a) Systems receive the Cryptosporidium treatment credit listed in this table by meeting the corresponding chlorine dioxide CT value for the applicable water temperature, as described in paragraph (1) of this rule.

CT Values (mg•min/L) for *Cryptosporidium* Inactivation by Chlorine Dioxide1

Log credit	**Water Temperature, °C**										
	<=0.5	**1**	**2**	**3**	**5**	**7**	**10**	**15**	**20**	**25**	**30**
0.25	159	153	140	128	107	90	69	45	29	19	12
0.5	319	305	279	256	214	180	138	89	58	38	24
1.0	637	610	558	511	429	360	277	179	116	75	49

1.5	956	915	838	767	643	539	415	268	174	113	73
2.0	1275	1220	1117	1023	858	719	553	357	232	150	98
2.5	1594	1525	1396	1278	1072	899	691	447	289	188	122
3.0	1912	1830	1675	1534	1286	1079	830	536	347	226	147

[1] Systems may use this equation to determine log credit between the indicated values: Log credit = [0.001506 x (1.09116)Temp] x CT

(b) Systems receive the Cryptosporidium treatment credit listed in this table by meeting the corresponding ozone CT values for the applicable water temperature, as described in paragraph (1) of this rule.

CT Values (mg•min/L) for *Cryptosporidium* Inactivation by Ozone[1]											
Log credit	**Water Temperature, °C**										
	<=0.5	**1**	**2**	**3**	**5**	**7**	**10**	**15**	**20**	**25**	**30**
0.25	6.0	5.8	5.2	4.8	4.0	3.3	2.5	1.6	1.0	0.6	0.39
0.5	12	12	10	9.5	7.9	6.5	4.9	3.1	2.0	1.2	0.78
1.0	24	23	21	19	16	13	9.9	6.2	3.9	2.5	1.6
1.5	36	35	31	29	24	20	15	9.3	5.9	3.7	2.4
2.0	48	46	42	38	32	26	20	12	7.8	4.9	3.1
2.5	60	58	52	48	40	33	25	16	9.8	6.2	3.9
3.0	72	69	63	57	47	39	30	19	12	7.4	4.7

[1] Systems may use this equation to determine log credit between the indicated values: Log credit = [0.0397 x (1.09757)Temp] x CT

(3) Site specific study. The Department may approve alternative chlorine dioxide or ozone CT values to those listed in paragraph (2) of this rule on a site-specific basis. The Department must base this approval on a site-specific study a system conducts that follows a Department-approved protocol.

(4) Ultraviolet light. Systems receive *Cryptosporidium*, Giardia lamblia, and virus treatment credits for ultraviolet (UV) light reactors by achieving the corresponding UV dose values shown in subparagraph (4)(a) of this rule below. Systems must validate and monitor UV reactors as described in subparagraphs (4)(b) and (c) below to demonstrate that they are achieving a particular UV dose value for treatment credit.

(a) UV dose table. The treatment credits listed in this table are for UV light at a wavelength of 254 nm as produced by a

low pressure mercury vapor lamp. To receive treatment credit for other lamp types, systems must demonstrate an equivalent germicidal dose through reactor validation testing, as described in subparagraph (4)(b) below. The UV dose values in this table are applicable only to post-filter applications of UV.

UV dose table for *Cryptosporidium*, *Giardia lamblia*, and virus inactivation credit

Log credit	***Cryptosporidium* UV dose (mJ/cm^2)**	***Giardia lamblia* UV dose (mJ/cm^2)**	**Virus UV dose (mJ/cm^2)**
0.5	1.6	1.5	39
1.0	2.5	2.1	58
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	15	15	163
4.0	22	22	186

(b) Reactor validation testing. Systems must use UV reactors that have undergone validation testing to determine the operating conditions under which the reactor delivers the UV dose required in subparagraph (4)(a) of this rule above (i.e., validated operating conditions). These operating conditions must include flow rate, UV intensity as measured by a UV sensor, and UV lamp status.

1. When determining validated operating conditions, systems must account for the following factors: UV absorbance of the water; lamp fouling and aging; measurement uncertainty of online sensors; UV dose distributions arising from the velocity profiles through the reactor; failure of UV lamps or other critical system components; and inlet and outlet piping or channel configurations of the UV reactor.

2. Validation testing shall include the following: Full scale testing of a reactor that conforms uniformly to the UV reactors used by the system and inactivation of a test microorganism whose dose response characteristics have been quantified with a low pressure mercury vapor lamp.

3. The Department may approve an alternative approach to validation testing provided the system shows that the alternative approach proves at least equivalent results.

(c) Reactor monitoring.

1. Systems must monitor their UV reactors to determine if the reactors are operating within validated conditions, as determined under subparagraph (4)(b) of this rule

above. This monitoring must include UV intensity as measured by a UV sensor, flow rate, lamp status, and other parameters the Department designates based on UV reactor operation. Systems must verify the calibration of UV sensors and must recalibrate sensors in accordance with a protocol the Department approves.

2. To receive treatment credit for UV light, systems must treat at least 95 percent of the water delivered to the public during each month by UV reactors operating within validated conditions for the required UV dose, as described in subparagraphs (4)(a) and (4)(b) of this rule. Systems must demonstrate compliance with this condition by the monitoring required under subparagraph (4)(c)1. of this rule.

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